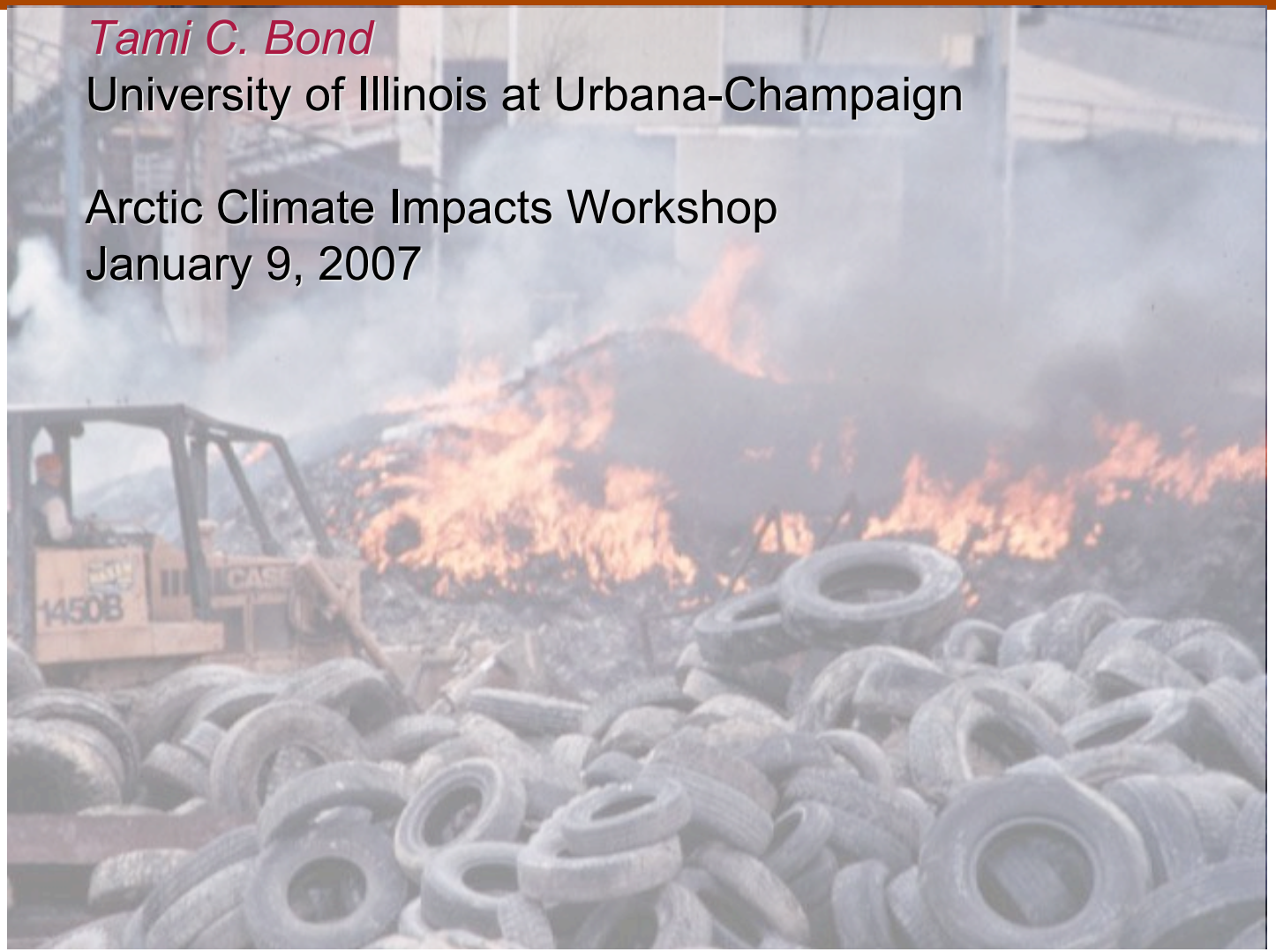
What do we know about sources of black carbon?



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Arctic Climate Impacts Workshop
January 9, 2007

Framing (*for this presentation*)

- **Assumption**: Black carbon reductions would positively affect the Arctic
  - *direct (reduce changes in Arctic snow/ice/clouds)*
  - *indirect (reduce warming)*
- **Question:** Do we know enough to identify & reduce sources?
- **Answer:** (Yes, some of them.)

Off-line discussions possible:

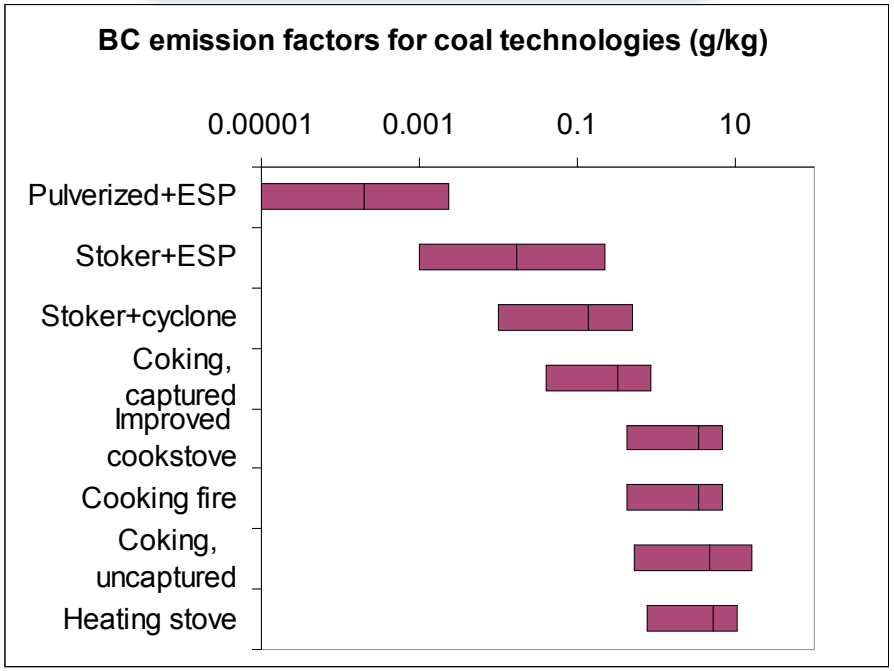
- Intimate details of building emission inventory
- Combustion source characterization– how do we know emission quantities & properties
- Definitions & equivalence: black carbon, absorption, elemental carbon, relationship between them
- Estimate of direct global warming potential (GWP) for black carbon
- Cookstoves, combustion improvement

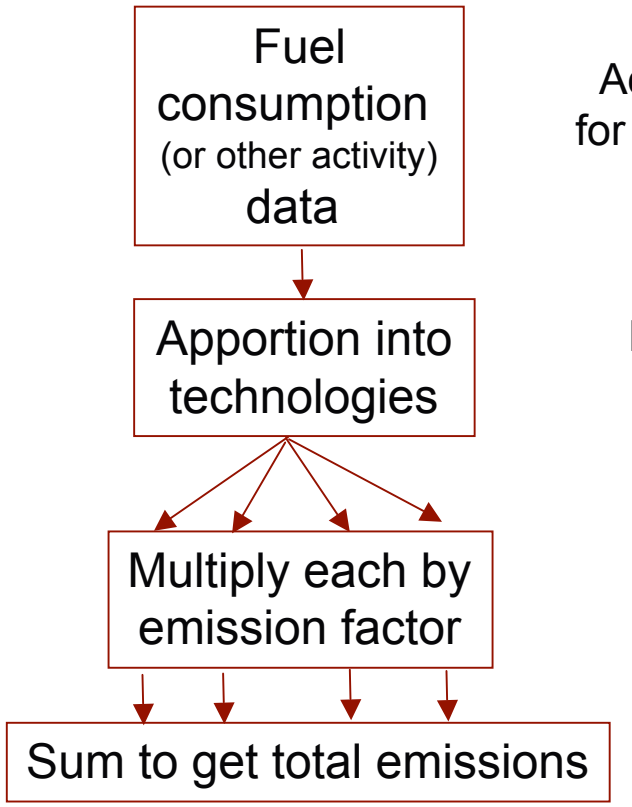
Outline

1. Emission inventory construction & confessions
2. Regional sources
   Europe, Former USSR, Asia
3. Mitigation potential

Emission inventory procedure (just add data)

Technology matters





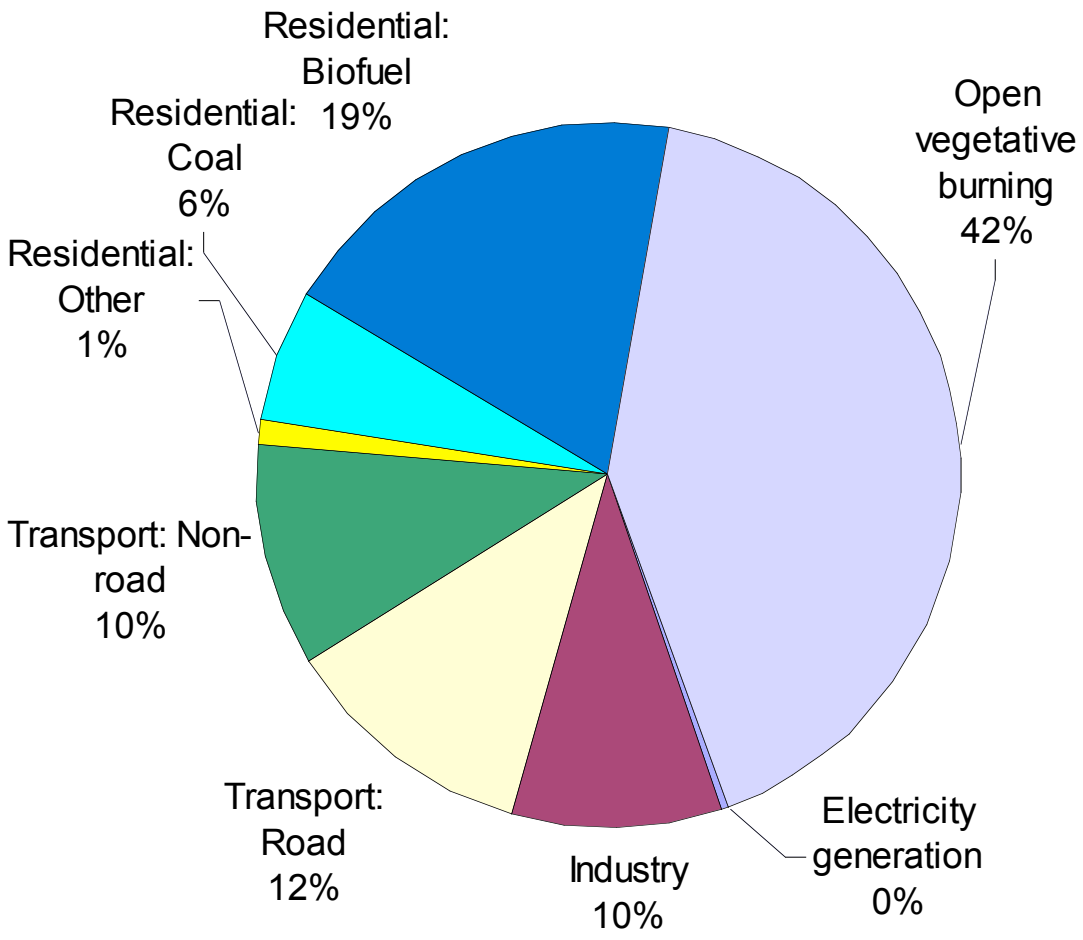
Major uncertainties

Activity data for unrecorded uses

Divisions

1. emission inventory

Global BC emissions

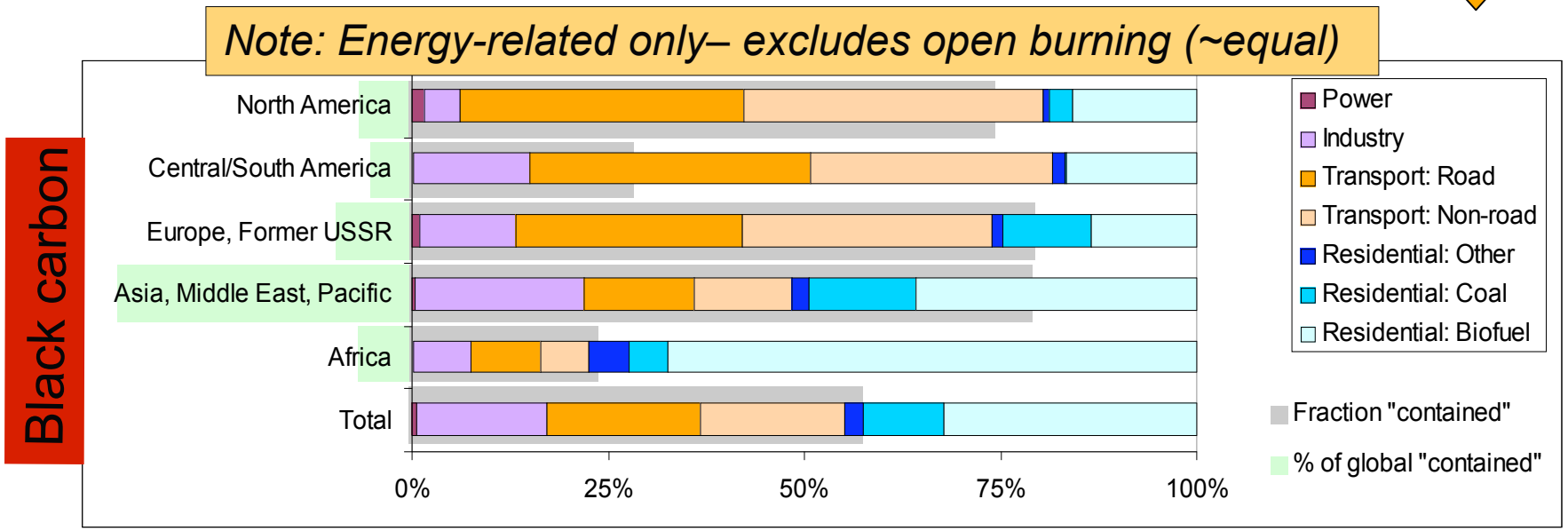


1. emission inventory

Expected sources of black carbon

- BC from solid fuels in residential sector
- BC from industry
- BC from transportation/diesel

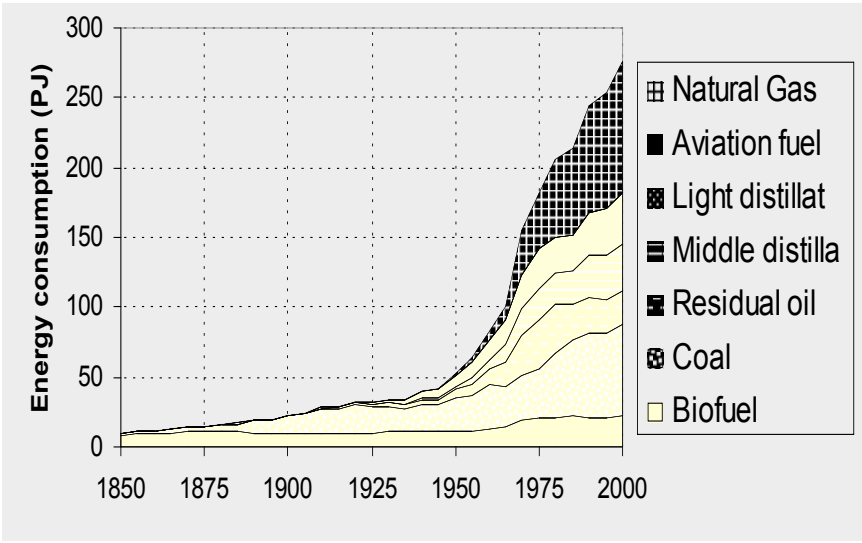
development path

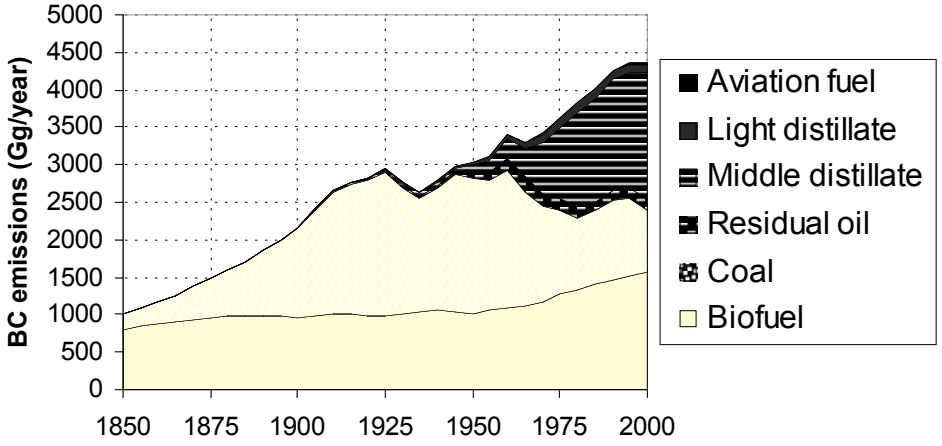


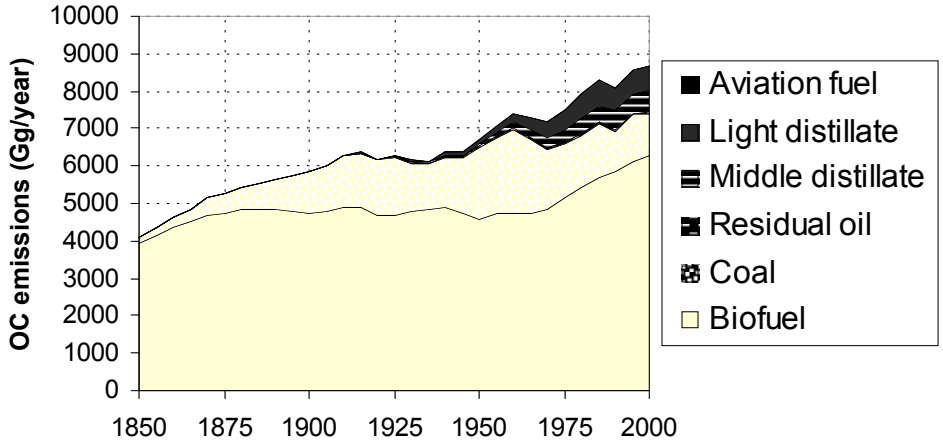
Bond, Streets et al., JGR 109, D14203, doi:10.1029/2003JD003697

1. emission inventory

Trend of BC+OC emission has been far different than that of GHGs.







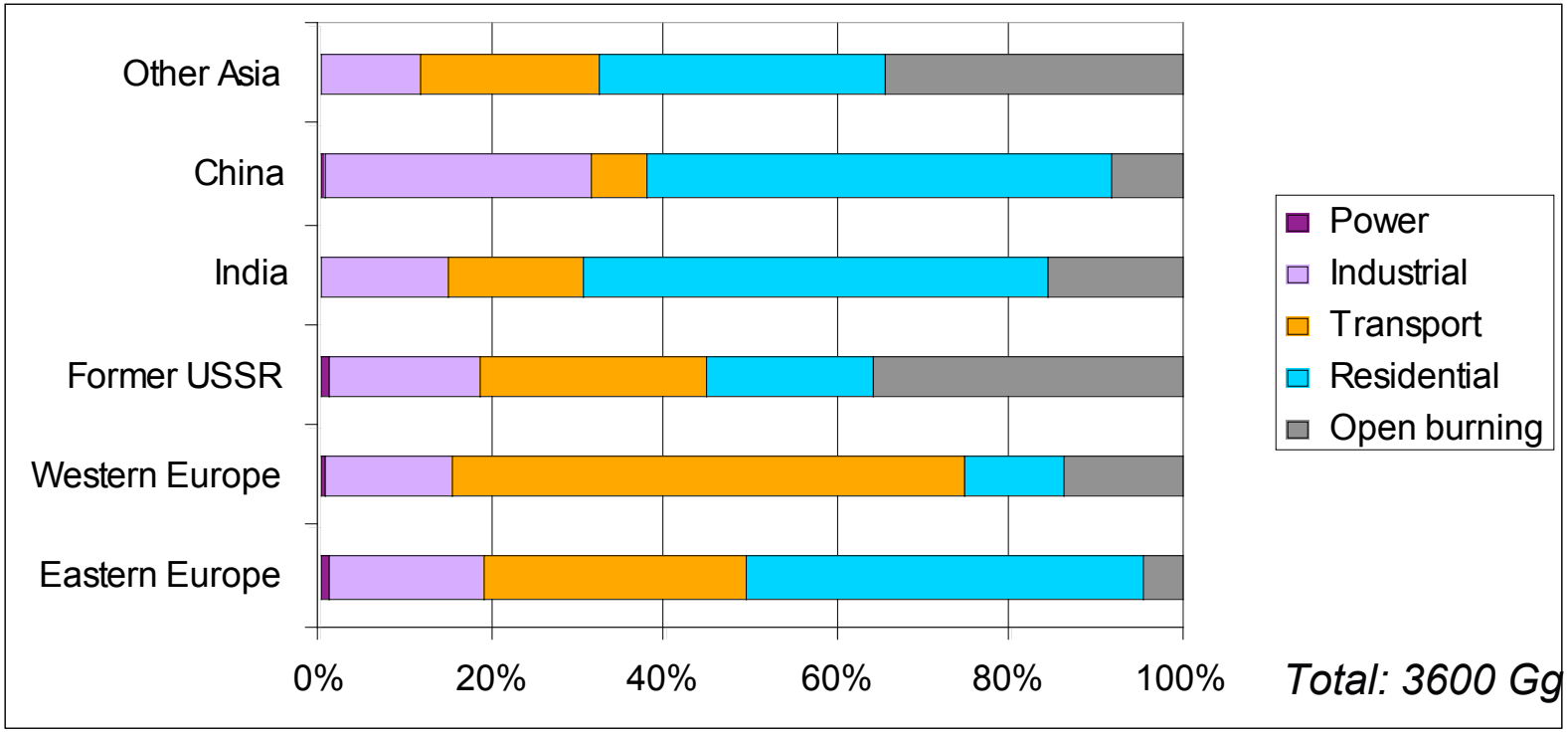
1. emission inventory

Example: The contribution of high emitters

- Normal vehicle with current Euro standards:
  0.8 g BC/kg fuel
- Superemitting vehicle:
  6.8 g BC/kg fuel

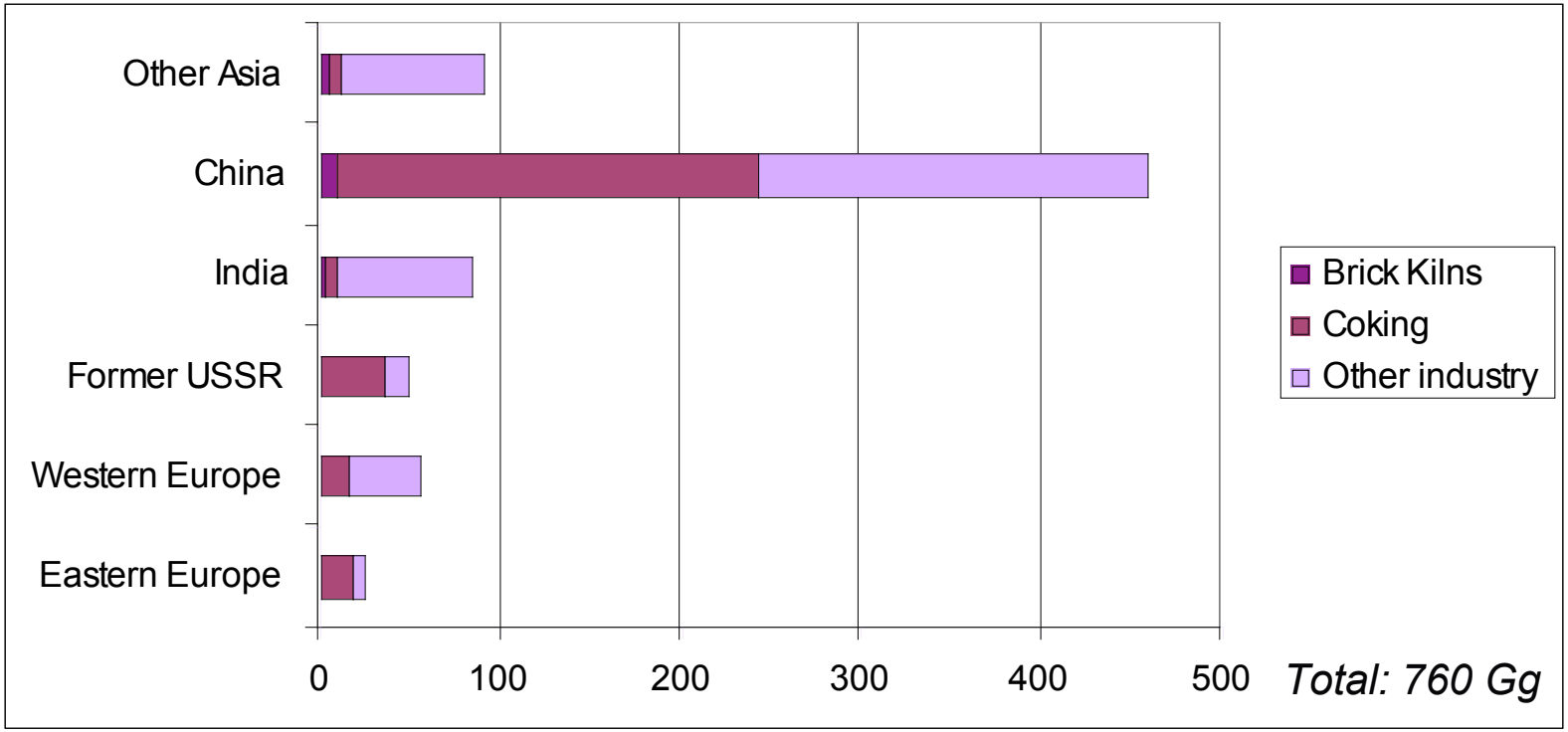
- If 5% superemitters:
  Fleet average = 1.1 g/kg
- One-third of emissions come from 5% of the vehicles

Emission breakdown for Arctic input regions



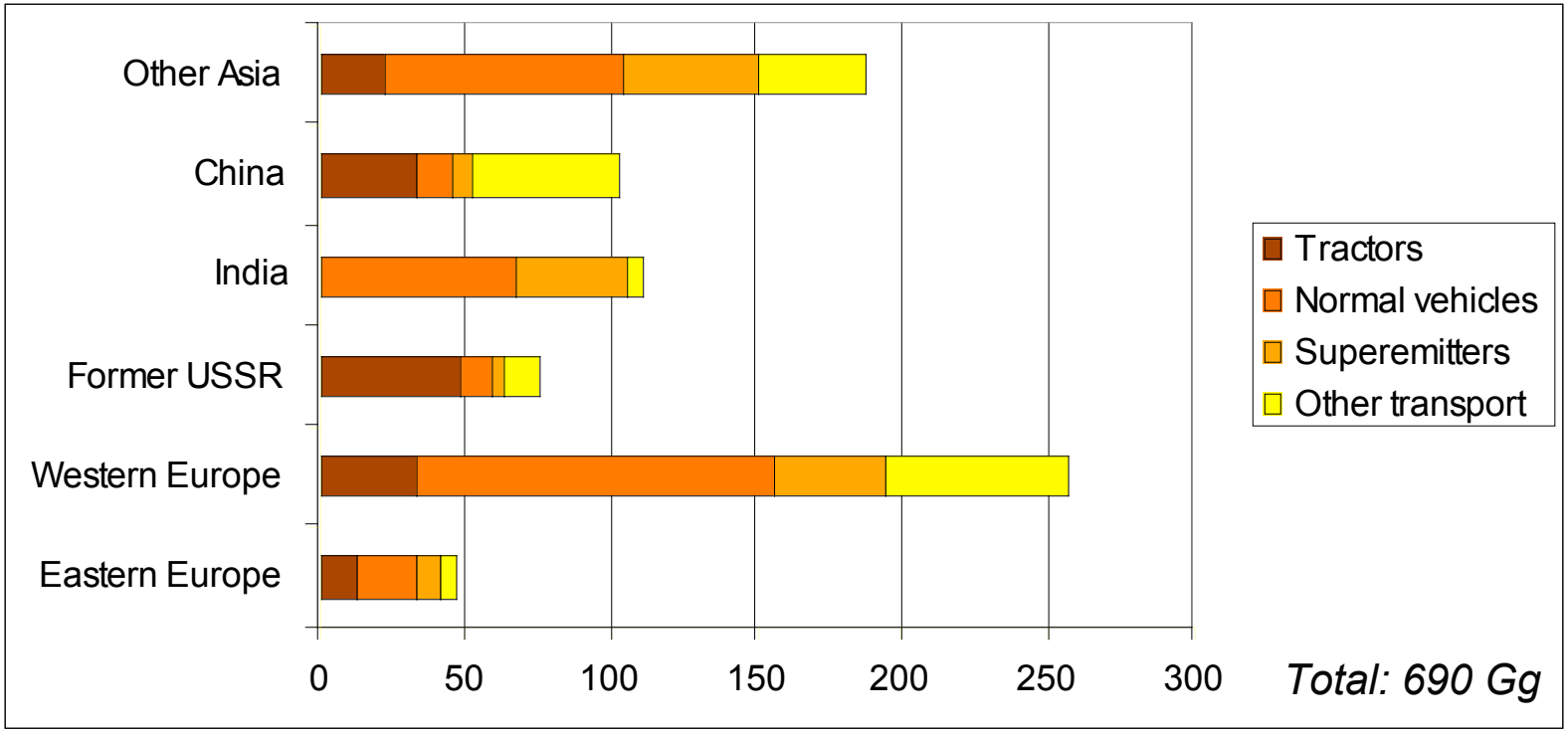
2. regional emissions

Emission breakdown for industry



2. regional emissions

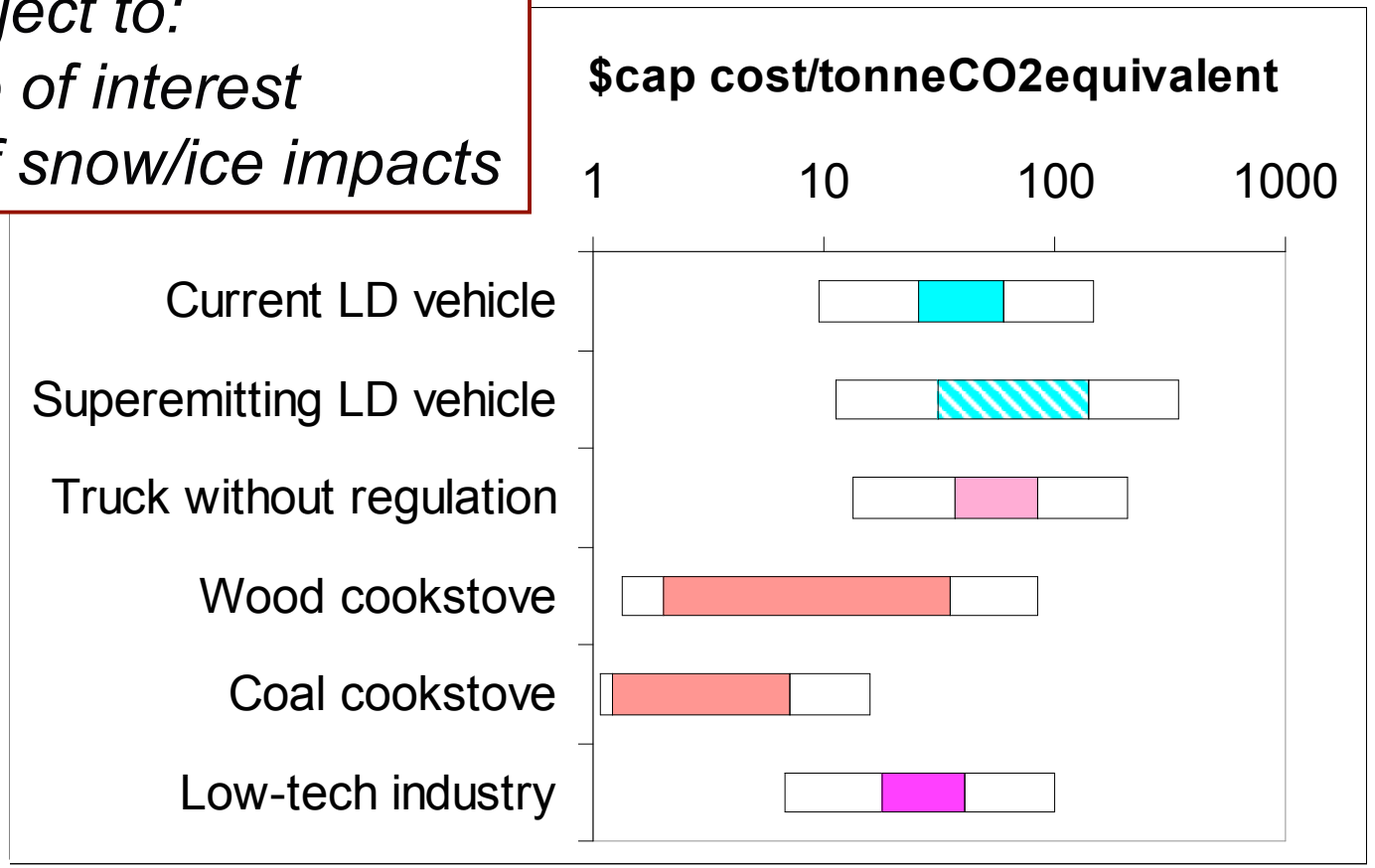
Emission breakdown for transport



2. regional emissions

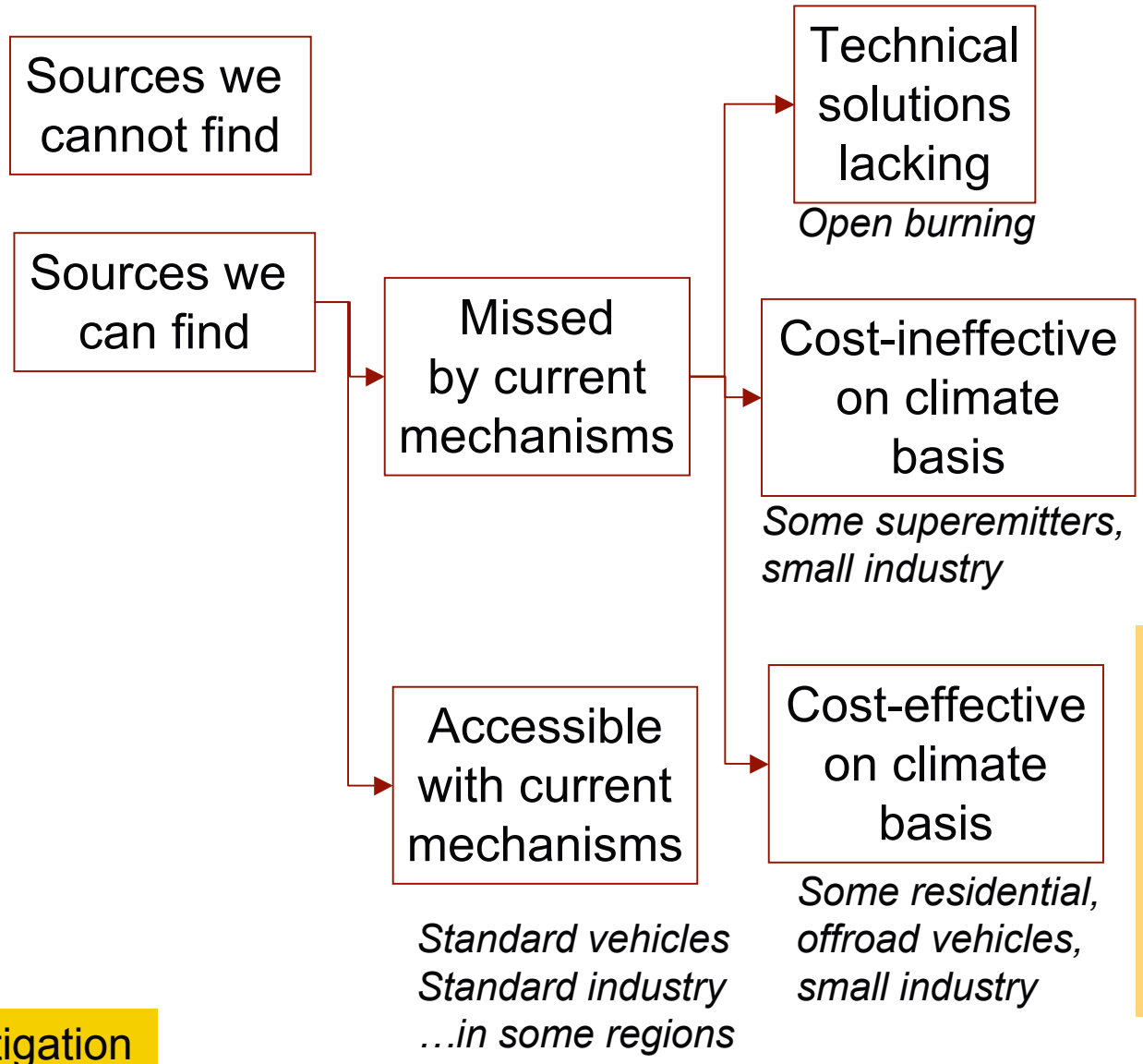
Cost estimates

Using GWP-100 of 680
(Bond & Sun, ES&T 39, 5921, 2005)
GWP is subject to:
-Time frame of interest
- Addition of snow/ice impacts



3. mitigation

Divide sources into mitigation brackets



Caveats:
- Borderline cost-effective
-May lack consumer acceptance
- Organic carbon/IE offset

3. mitigation